INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Worldwide biodiesel is being produced mainly from edible and non-edible oils. The choice of oil depends primarily on availability, price, and the policy adopted by the governing agencies. The economic aspects of biodiesel production are the barriers for its commercial success. The production of biodiesel from non-edible oils may offer solutions for various issues involved in the assessment of biomass-based industry for energy generation. Currently, non-edible rubber seed oil extracted from seeds of rubber trees is getting more attention for production of biofuel. The useful properties of the rubber seed oil make it similar to well-known linseed and soybean oil. The present work divided in to three major parts; extraction of oil, transesterification through non-conventional catalysts and techniques and solid by product utilization to cover major aspects of comprehensive utilization of rubber seeds biofuels production. Rubber seed kernel was subjected to oil extraction process. Response surface methodology (RSM) was applied to optimize the process parameters to achieve maximum oil yield (49.36wt%) with hexane as solvent. The extracted rubber seed oil (RSO) was found to contain high free fatty acid (FFA) (12%) as compared to edible vegetable oils (~1%). Since RSO is a high FFA oil, a two-step procedure, esterification using H_2SO_2 catalyst followed by transesterification with heterogeneous catalyst was used for rubber oil methyl ester (ROME) synthesis. The maximum conversion (~97%) was achieved at catalyst loading of 5.38wt% with MR of 8.09:1 in 13.20min using ultrasonic-assisted transesterification technique. Further, the rheological behaviour of RSO and its derivative esters as well as ROME blends with diesel fuel were investigated. The dynamic viscosity at 25°C was found to be 25.58mPa.s and 4.485mPa.s for RSO and ROME, respectively. Further, the solid wastes generated during biodiesel feedstock preparation process comprise 40–48wt% rubber seed shell (RSS) and 25–30wt% rubber seed cake (RSC) was used to produce liquid fuel and bio-char. Active pyrolysis zones of RSC (175–589°C) and RSS (265.2–530°C) were broadly observed in three and two stages, respectively. The maximum yield of RSS pyrolytic liquid (46.14wt%) and carbon-rich RSS bio-char (31.92wt%) were obtained at 550°C at a heating rate of 30°C/min. While for RSC the maximum of pyrolytic liquid (48.25wt%) and carbon-rich RSS bio-char (26.18wt%) yield were obtained at 500°C temperature at heating rate of 20°C/min. The fuel characteristics of produced bio-char (from RSS) such as higher calorific value (34.5MJ/kg), higher fixed carbon (79.74wt%), lower ash (1.87wt%) and lower moisture content (2.11wt%) were found better than that of RSC bio char. However, the liquid product (organic phase) obtained from pyrolysis of RSC showed much higher calorific value than RSS pyrolytic liquid. Further, the yield and quality of organic phase (bio-oil) during RSC pyrolysis was enhanced by co-pyrolysis process through addition of waste polystyrene. In depth analysis of physico-chemical-thermal properties of RSS and RSC obtained products (liquid and bio-char) using various analytical techniques suggested that both RSS and RSC can be considered as a suitable feedstock for the production of value added chemicals including fuel.